Numerical Simulation of Hydro- and Magnetohydrodynamical Processes in the Muon Collider Target

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We have developed numerical methods and performed numerical simulations of the proposed Muon Collider target. The target will be designed as a pulsed jet of mercury interacting with strong proton beams in a 20 Tesla magnetic field. A numerical approach for the numerical simulation of magnetohydrodynamical flows in discontinuous media was implemented in FronTier, a hydrodynamics code with free interface support. The FronTier-MHD code was used to study the evolution of the mercury jet in the target solenoid system. To model accurately the interaction of the mercury target with proton pulses, a realistic equation of state for mercury was created in a wide temperature - pressure domain which includes the liquid - vapor phase transition and the critical point. The numerical simulation of the mercury target - proton pulse interaction during 120 microseconds was performed using the FronTier code with the two phase equation of state. According to the simulation results, the mercury target will be broken into a set of droplets due to the proton energy deposition and the radial velocity of the jet surface before the droplet formation will be in the range 20 - 60 m/sec.

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